

Claims:

What is claimed is:

1 1. A method of coating a surface of a substrate with a polymer
2 solution, comprising:

3 mounting the substrate inside an enclosed housing;

4 controlling a solvent vapor concentration of a control
5 gas to be greater than approximately 50% (saturation);

6 passing the control gas into the housing through an
7 inlet;

8 extruding the polymer solution onto the surface of the
9 substrate in the housing;

10 spinning the substrate; and

11 exhausting the control gas and any solvent vapor and
12 particulate contaminants suspended in the control gas from the housing
13 through an outlet.

1 2. The method of claim 1, wherein the substrate is a wafer having
2 a top surface, a center, and an outer edge; and

3 wherein extruding the polymer solution comprises extruding a ribbon
4 of photoresist, the ribbon having a width, the ribbon covering the entire top

5 surface of the substrate in a spiral pattern, wherein the photoresist is extruded

6 from the extrusion slot at a rate which is a constant extrusion rate, and with the

7 substrate rotating at a rotational speed, and the extrusion head moving at a

8 radial speed, the motion of a radially moving extrusion head with respect to

9 the rotating substrate is at a tangential velocity which is a constant tangential

10 velocity.

11 bounded by a first end and a second end, the extrusion head positioned with
12 the extrusion slot aligned radially with respect to the wafer, the first end of the
13 extrusion slot located adjacent to the outer edge of the wafer, and the second
14 end of the extrusion slot outside the outer edge of the wafer,
15 rotating the wafer about its center, wherein with the wafer rotating at a
16 rotational speed, and the extrusion head moving at a radial speed, the motion
17 of a radially moving extrusion head with respect to the rotating wafer is at a
18 tangential velocity which is a constant tangential velocity;
19 extruding a ribbon of photoresist from the extrusion slot, the ribbon
20 having a width which is substantially equal to the length of the slot, wherein
21 the photoresist is extruded from the extrusion slot at a rate which is a constant
22 extrusion rate, and
23 while extruding photoresist from the extrusion slot, and maintaining
24 the extrusion slot aligned radially with respect to the wafer, moving the
25 extrusion head radially inward from the outer edge of the wafer toward the
26 center of the wafer until the photoresist covers the entire top of the surface of
27 the wafer.

1 7. A method according to claim 6, wherein the length of the
2 extrusion slot is between about one tenth and one third of the diameter of the
3 semiconductor wafer.

1 13. The method of claim 1, wherein:
2 the substrate is a wafer having a top surface, a center, a diameter, and
3 an outer edge;
4 mounting the substrate inside an enclosed housing comprises mounting
5 the wafer on a chuck; and
6 extruding the polymer solution comprises:
7 positioning an extrusion head at the center of the wafer and above the
8 top surface of the wafer, the extrusion head configured to extrude photoresist
9 out an extrusion slot, the extrusion slot having a length bounded by a first end
10 and a second end, the extrusion head positioned with the extrusion slot aligned
11 radially with respect to the wafer, the first end of the extrusion slot located at
12 the center of the wafer and the second end of the extrusion slot located
13 between the center of the wafer and the outer edge of the wafer,
14 rotating the wafer about its center wherein with the wafer rotating at a
15 rotational speed, and the extrusion head moving at a radial speed, the motion
16 of a radially moving extrusion head with respect to the rotating wafer is at a
17 tangential velocity which is a constant tangential velocity,
18 extruding a ribbon of photoresist from the extrusion slot, the ribbon
19 having a width substantially equal to the length of the slot, wherein the
20 photoresist is extruded from the extrusion slot at a rate which is a constant
21 extrusion rate, and
22 while extruding photoresist from the extrusion slot, and maintaining
23 the extrusion slot aligned radially with respect to the wafer, moving the

24 extrusion head radially outward toward the outer edge of the wafer until the
25 photoresist covers the entire top surface of the wafer.

1 14. The method of claim 1, wherein controlling a solvent vapor
2 concentration comprises
3 passing a first solvent vapor-bearing gas and a second gas to the
4 housing along conduits in which electrically-controlled valves are mounted,
5 the valves controlling a gas flow rate into the housing and the composition of
6 the control gas flowing into the housing.

1 15. The method of claim 2, wherein controlling a solvent vapor
2 concentration comprises
3 passing a first solvent vapor-bearing gas and a second gas to the
4 housing along conduits in which electrically-controlled valves are mounted,
5 the valves controlling a gas flow rate into the housing and the composition of
6 the control gas flowing into the housing.

1 16. The method of claim 6, wherein controlling a solvent vapor
2 concentration comprises:
3 passing a first solvent vapor-bearing gas and a second gas to the
4 housing along conduits in which electrically-controlled valves are mounted,
5 the valves controlling a gas flow rate into the housing and the composition of
6 the control gas flowing into the housing.

[illegible]

17. The method of claim 13, wherein controlling a solvent vapor concentration comprises

passing a first solvent vapor-bearing gas and a second gas to the housing along conduits in which electrically-controlled valves are mounted, the valves controlling a gas flow rate into the housing and the composition of the control gas flowing into the housing.

1 18. The method of claim 1, wherein the control gas comprises at
2 least one species selected from a group consisting of air, nitrogen, and noble
3 gases.

1 19. The method of claim 2, wherein the control gas comprises at
2 least one species selected from a group consisting of air, nitrogen, and noble
3 gases.

1 20. The method of claim 6, wherein the control gas comprises at
2 least one species selected from a group consisting of air, nitrogen, and noble
3 gases.

1 21. The method of claim 13, wherein the control gas comprises at
2 least one species selected from a group consisting of air, nitrogen, and noble
3 gases.

1 22. The method of claim 1, wherein the polymer solution contains
2 a photoresist polymer.

1 23. The method of claim 2, wherein the polymer solution contains
2 a photoresist polymer.

1 24. The method of claim 6, wherein the polymer solution contains
2 a photoresist polymer.

1 25. The method of claim 13, wherein the polymer solution contains
2 a photoresist polymer.

1 26. The method of claim 1, further comprising passing solvent-free,
2 humid gas over the coated substrate.

1 27. The method of claim 2, further comprising passing solvent-free,
2 humid gas over the coated substrate.

1 28. The method of claim 6, further comprising passing solvent-free,
2 humid gas over the coated substrate.

1 29. The method of claim 13, further comprising passing solvent-
2 free, humid gas over the coated substrate.

1 30. The method of claim 26, wherein a humidity of the humid gas
2 is controlled by means of a temperature and humidity controller.

1 31. The method of claim 30, wherein the humidity of a humid gas
2 is controlled to have the relative humidity in the range of 40% to 45%.

1 32. The method of claim 1, wherein the temperature of the humid
2 gas is controlled by means of a temperature and humidity controller.

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